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Geological framework for representing subsurface heterogeneity relevant for piping

T.G. Winkels*[1], E. Stouthamer[1], K.M. Cohen[1,2], H. Middelkoop[1]

[1] Utrecht University, Department of Physical Geography, Faculty of Geosciences, P.O. 80.115, 3508 TC, Utrecht, the Netherlands
[2] Department of Applied Geology and Geophysics, Deltares, P.O. 85467, 3508 AL, Utrecht, the Netherlands.

*Corresponding author; e-mail: t.g.winkels@uu.nl

Sandy substrate map

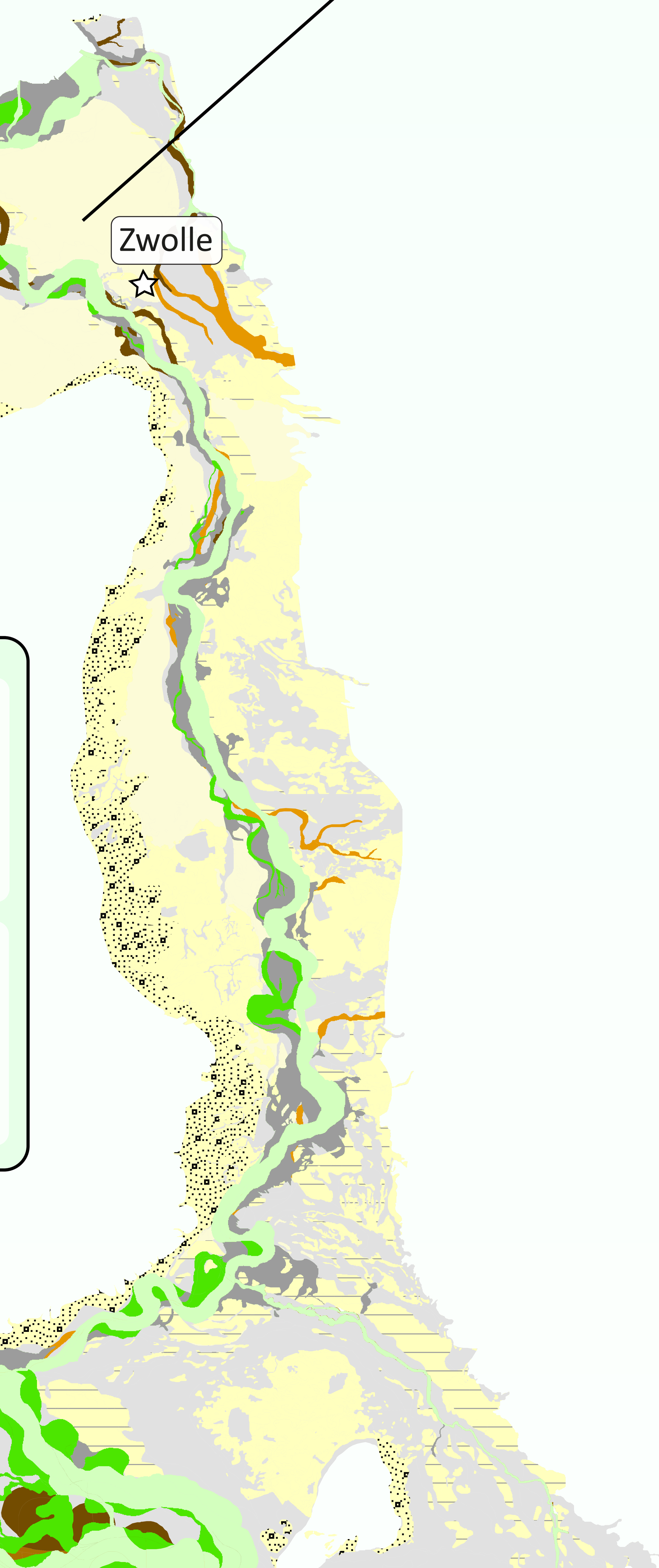
Acquiring relevant parameters from the geological record requires a detailed knowledge about the **depositional systems** in combination with the geological (delta) setting. Within this project we aim to summarize and provide a theoretical background for variations in dimensions (architectural elements) and composition (lithofacies) across the fluvially dominated part of the Rhine-Meuse delta.

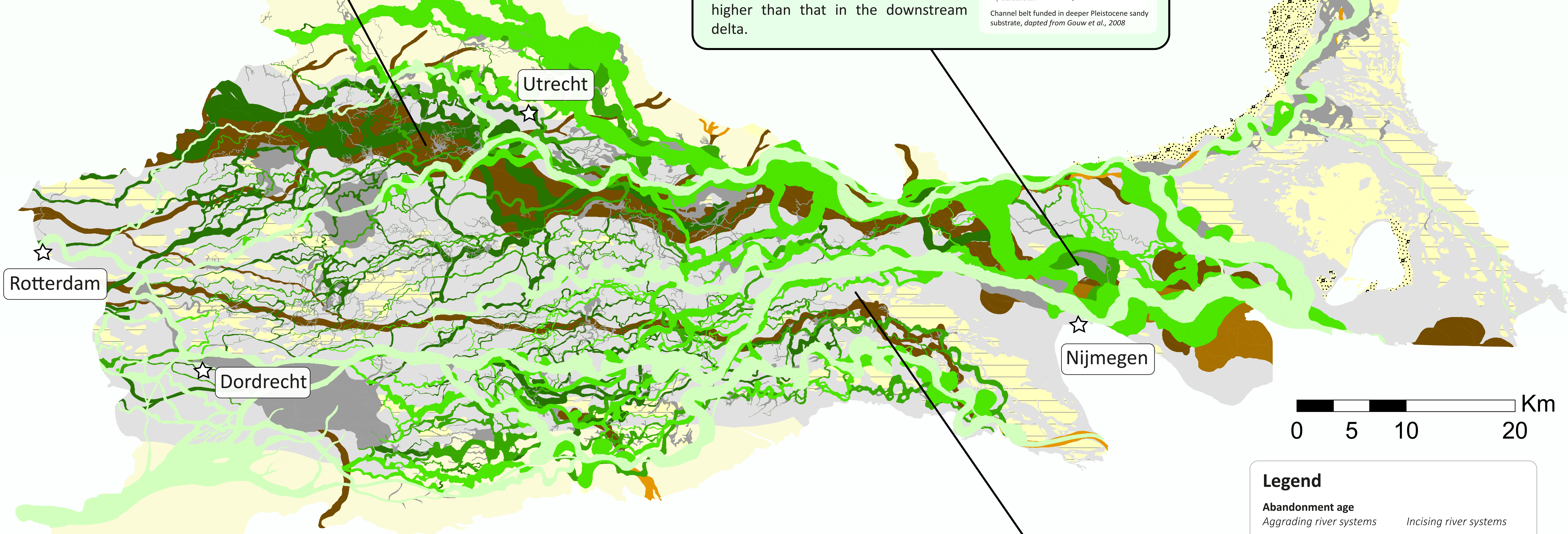
The **sandy substrate** forms the starting point for defining the occurring architectures and sequences forming the subsurface scenarios, as this is the substrate in which the backward erosion process takes place. The occurrence of all sandy depositional units are combined to create a substrate map showing the genesis of the upper sand units of >0.5 m thick preserved in the subsurface sequence.

Sandy sheet deposits:

Sandy sheet deposits function as the main aquifer in which younger isolated sand bodies can possibly found themselves. The study area is characterized by two main sheet deposits.

1) **Braided fluvial deposits** (grey)
2) **Cover and deposits** (yellow)





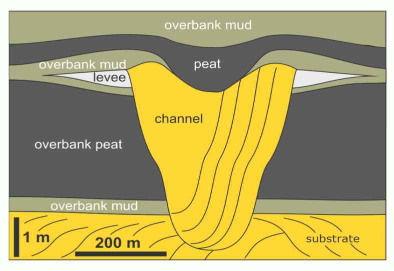
Multiple channel belt generations:

During the Holocene avulsions of river systems resulted the abandonment of channels and the formation of new ones. Over time this resulted in a diverse landscape with multiple generations of (paleo) channel belts in the subsurface. In this project we subdivide these paleo channel belt deposits into four different generations based on changes in sediment supply and depositional setting.

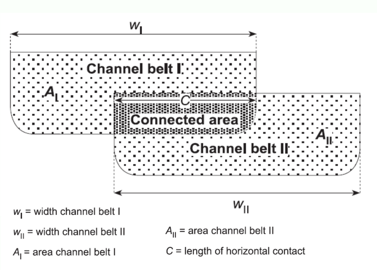
Abandonment age	
>5000yr BP	Fast increase in accommodation space due to sea level rise
5000-3000 yr BP	Relatively stable accommodation space
3000-800 yr BP	Increase in fine sediment load (Erkens, 2006)
<800 yr BP	Fully embanked river systems

Connectivity Channel belts:

Connectivity with these deeper aquifers can drastically increase the thickness of the water-bearing aquifer and changes hydrological boundary conditions relevant for piping. Furthermore, individual sand bodies can also be connected with older deeper sand bodies. The connectedness ratio (CR) (cf. Mackey & Bridge, 1995) is important as it implies the reworking of older deposits. Gouw (2008) already found that CR in the upstream part of the study area is more than two times higher than that in the downstream delta.



Channel belt funded in deeper Pleistocene sandy substrate, *adapted from Ghinassi et al., 2016*



Channel belt funded in deeper Pleistocene sandy substrate, *dapted from Gouw et al., 2008*

Channel belt geometry:

Geometry of Holocene channel belts changes drastically through the study area. Width of channel belts decreases by a factor of 4 to 6 in the downstream direction (Gouw, 2008) depending on (delta)substrate and overbank deposits.

Legend

Abandonment age

Aggrading river systems
- >5000 yr BP
- 5000- 3000 yr BP
- 3000 - 800 yr BP
- Active systems

Incising river systems
- >5000 yr BP
- 5000- 3000 yr BP
- 3000 - 800 yr BP
- Active systems

- Crevasses
- Pleistocene fluvial deposits
- Coversand deposits
- River dunes
- Local Alluvium

Geological framework

The resulting sandy substrate map provides a tool for the regional subdivision of the Rhine-Meuse delta's subsurface, with per area distinct fluvial sequences, and help in better understanding the build-up of the geological subsurface and its potential for piping beneath river embankments. In the next phase will be incorporating the thickness and composition of overbank deposits covering the sandy substrate.

References:
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